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Before You Begin

The NASA-developed Earth Observing System (EOS) Clearinghouse (ECHO) is a spatial and temporal metadata registry that enables the science community to more easily use and exchange NASA's data and services. ECHO's main objective is to enable broader use of NASA's EOS data. It allows users to more efficiently search and access data and services and increases the potential for interoperability with new tools and services. The value of these resources increases as the potential to exchange and inter-operate increases. ECHO has been working with other organizations to provide their Earth science metadata alongside NASA's for users to search and access. ECHO stores metadata from a variety of science disciplines and domains, including Climate Variability and Change, Carbon Cycle and Ecosystems, Earth Surface and Interior, Atmospheric Composition, Weather, and Water and Energy Cycle.

NASA's Earth science data has already proven itself to be extremely useful in understanding the planet Earth as an integrated system. To help science communities that need data from multiple organizations and multiple disciplines, ECHO provides a uniform view of NASA's data. It allows users to more efficiently search and access data and services and increases the potential for interoperability with new tools and services. For examples of how NASA's Earth science data is helping scientists understand the complexities of our Earth, visit Sensing our Planet and Other Featured Research Articles at <https://earthdata.nasa.gov/>.

ECHO was designed to increase access to NASA Earth science data and services by providing a system with a machine-to-machine interface, that is, an Application Programming Interface (API). This API facilitates the discovery, online access, and order brokering for a Data Partner's data holdings. ECHO Data Partners retain complete control over what metadata are represented in ECHO by means of inserting new metadata, modifying existing metadata, removing old metadata, and controlling access to their metadata. ECHO Client Partners develop client applications that access the ECHO API and take advantages of the services made available. These clients, such as Reverb (<https://reverb.echo.nasa.gov>) allow end users to discover data which has been registered in ECHO's holdings and can be custom made to meet the needs of a general user audience, or a specific science application.

Data Partner Tasks

Usually performed in the order shown below:

- Generating metadata compliant with ECHO's xml format
- Ingesting your metadata into ECHO
- Managing holdings within ECHO
 - Access Control
 - Reconciliation
- Fulfilling Orders

- Creating and managing order definitions
- Supporting order fulfillment for ECHO submitted orders

Data Partner Skills

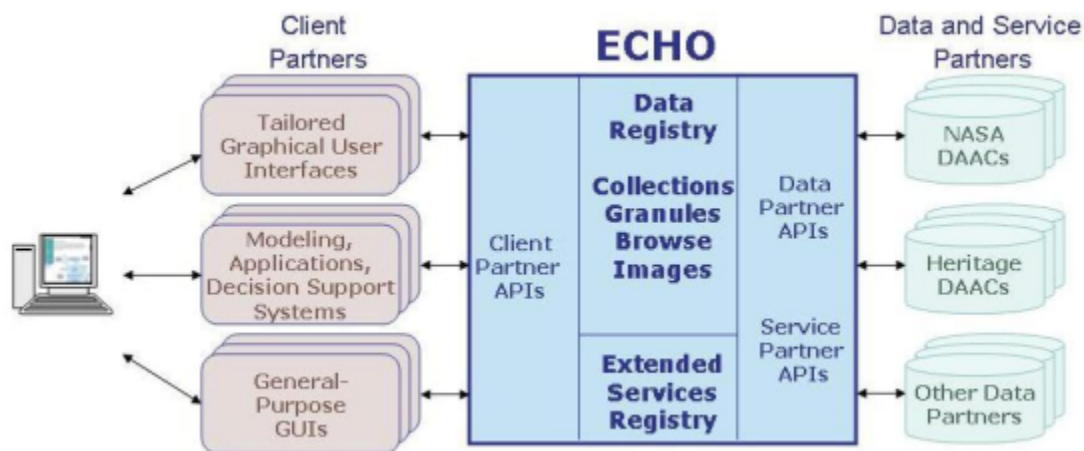
Since ECHO uses platform-independent web service definitions for its API, there are no requirements for a client programming language. All examples in this document are in snippets of Java code; however, the code samples provided could be translated to any web service capable language.

As an ECHO Data Partner, you need to be familiar with basic software development and Service Oriented Architecture (SOA) concepts such as:

- XML and XML Schema (XSD)
- Web Service Definition Language (WSDL)
- Service-based Application Programmer's Interface (API)

ECHO concept and design

NASA's Earth Science Data and Information System (ESDIS) has built ECHO based on Extensible Markup Language (XML) and Web Service technologies. ECHO interfaces with different clients and users through its series of Application Program Interfaces (APIs). ECHO is an open system with published APIs available to the ECHO Development and User community.



ECHO System Concept

Internally, ECHO specifies APIs and provides middleware components, including data and service search and access functions, in a layered architecture. The figure below depicts the ECHO system context in relation to its public APIs.

ECHO allows Data Partners to cache copies of their metadata within it. Data Partners have complete control over what metadata ECHO represents on their behalf. You, as a Data Partner, can insert new data, modify existing data, and remove old data.

All ECHO metadata is stored in an Oracle database with spatial extensions. The metadata model is derived primarily from that used by the Earth Observing System Data and Information System (EOSDIS) Core System (ECS). For more details about the ECHO model, refer to the ECHO Ingest documentation available here: <https://api.echo.nasa.gov/ingest/>

Key features of the ECHO architecture are:

- *Ease of Partner Participation* – Designed to be low-cost and minimally intrusive, ECHO offers a set of standard ways for partners to interface with the system and a metadata exchange approach that accommodates existing partners and technology.
- *Open System/Published APIs* – To accommodate independent ECHO clients, ECHO uses an open system approach and publishes domain APIs. These APIs are independent of the underlying transport protocols used. ECHO communicates using WS-I Basic Profile v1.0 compliant web services. Documentation regarding the ECHO API can be viewed here: <http://api.echo.nasa.gov/echo/apis.html>.

Interactions with ECHO may involve user interactions in real time or may be machine to machine.

- *Evolutionary Development* – The ECHO system is being developed incrementally to allow for insight and feedback during the development cycle. Industry trends are followed and the use of commercial, off-the-shelf (COTS) products is optimized.

ECHO as a Spatially Enabled Metadata Search and Order System

ECHO allows Data Partners to define the spatial extent of a granule or a collection with different spatial constructs (for example: point and

polygon). These spatial extents may be in either the Geodetic or Cartesian coordinate systems. Orbital data may also be provided to describe a collection or granules spatial extents. A Client Partner can then construct a search using a point, a line, or a polygon (or multiple polygon) spatial type, and ECHO responds with data whose spatial region intersects the described region.

ECHO provides services for interacting with its **Catalog** of metadata. Queries can be performed in a number of ways; result contents can be specified, and the resulting data sets can be incrementally accessed so that large return sets can be handled gracefully. ECHO also supports constructing, submitting, and tracking orders for the data that the metadata represents. ECHO supports both an embedding of a Uniform Resource Locator (URL) within the metadata for accessing the data (which the client simply accesses via Hypertext Transfer Protocol [HTTP]) or File Transfer Protocol (FTP), and a more complicated order process in which quotes and order options are accommodated.

Security

The ECHO system requires Secure Sockets Layer (SSL)-based communication from Client Applications to the ECHO API and supports, but does not require, secure communication from ECHO to a Data Partner's order fulfillment service. Internally, the ECHO system is protected through a layer of software and hardware control mechanisms to preserve the integrity of ECHO's holdings. When configuring order fulfillment, Data Partners are strongly encouraged to utilize SSL communications (See Chapter 7 for more information)

ECHO Capability And Functionality

ECHO provides an infrastructure that allows various communities to share tools, services, and metadata. As a metadata clearinghouse, it supports many data access paradigms such as navigation and discovery. As an order broker, ECHO forwards orders for data discovered through the metadata query process to the appropriate Data Partners for order fulfillment. As a service broker, ECHO decentralizes end user functionality and supports interoperability of distributed functions.

Although this Guide focuses on the needs of Data Partners, ECHO supports the following different, nonexclusive types of Partners:

- *DataPartners* – Organizations that supply metadata representing their data holdings to the ECHO database
- *ClientPartners* – Organizations that participate by developing software applications to access the Earth science metadata in the ECHO database
- *ServicePartners* – Organizations that participate by advertising their Earth science-related services to the user community via ECHO, which maintains service descriptions in a Service Catalog (either special services, or services that are available as an option on a selected set of granules/collections) and support the user in ordering those services.

ECHO addresses science user needs through a set of well-defined and open interfaces upon which the user community can build its own client applications. In this way, ECHO supports extendable, flexible user interfaces, allowing industry and the science community to drive the progress of available Earth science applications. For more complete information about client applications, refer to the companion piece to this Guide, the *ECHOCClientPartner'sGuide*.

The ECHO approach allows users to build their own user interfaces to ECHO, rather than being limited to the data search and order system provided by NASA. For Data Partners, ECHO offloads the burden of providing the system resources required for searching and gives users the flexibility to support community-specific services and functionality. ECHO's interoperability features allow all participants to benefit from the distributed development of functions, again reducing dependence on NASA resources.

Benefits to Data Partners

ECHO'S open system provides Earth science data and services to a large, diverse pool of users, enabling scientific community interaction and collaboration. ECHO benefits Data Partners in the following ways.

- Makes data resources available to a wide ranges of potential users
- Virtual co-location with other data sources and services
- Common data language
- Enable loosely coupled application solutions
- Metadata and order subscription services
- Enhanced data control mechanisms

ECHO Systems

There are three ECHO Systems that you, as a Data Partner, have access to. A short description of each system is given below. For additional information, refer to the links below;

- **ECHO Operations** The ECHO Operational system is a production system which serves the needs of the Earth Science community. The Data Holdings within this system include those which ECHO's Data Partners have made available for use by the Earth Science community.
- **ECHO Partner Test** The ECHO Partner Test system is a test system which serves the needs of the ECHO Data, Client, and Service partners. The Data Holdings within this system include those which ECHO's Data Partners have made available for their own testing

purposes

- **ECHO Testbed** The ECHO Alpha Testbed system has been established in order to facilitate an exchange of ideas and provide early insight into the upcoming capabilities offered by ECHO.